



NOAA
FISHERIES

**Southeast Fisheries
Science Center**

Protected Species Bycatch Estimation

Southeast Fisheries Science Center
Protected Species Program Review

26 August 2015

Fisheries Bycatch Estimation

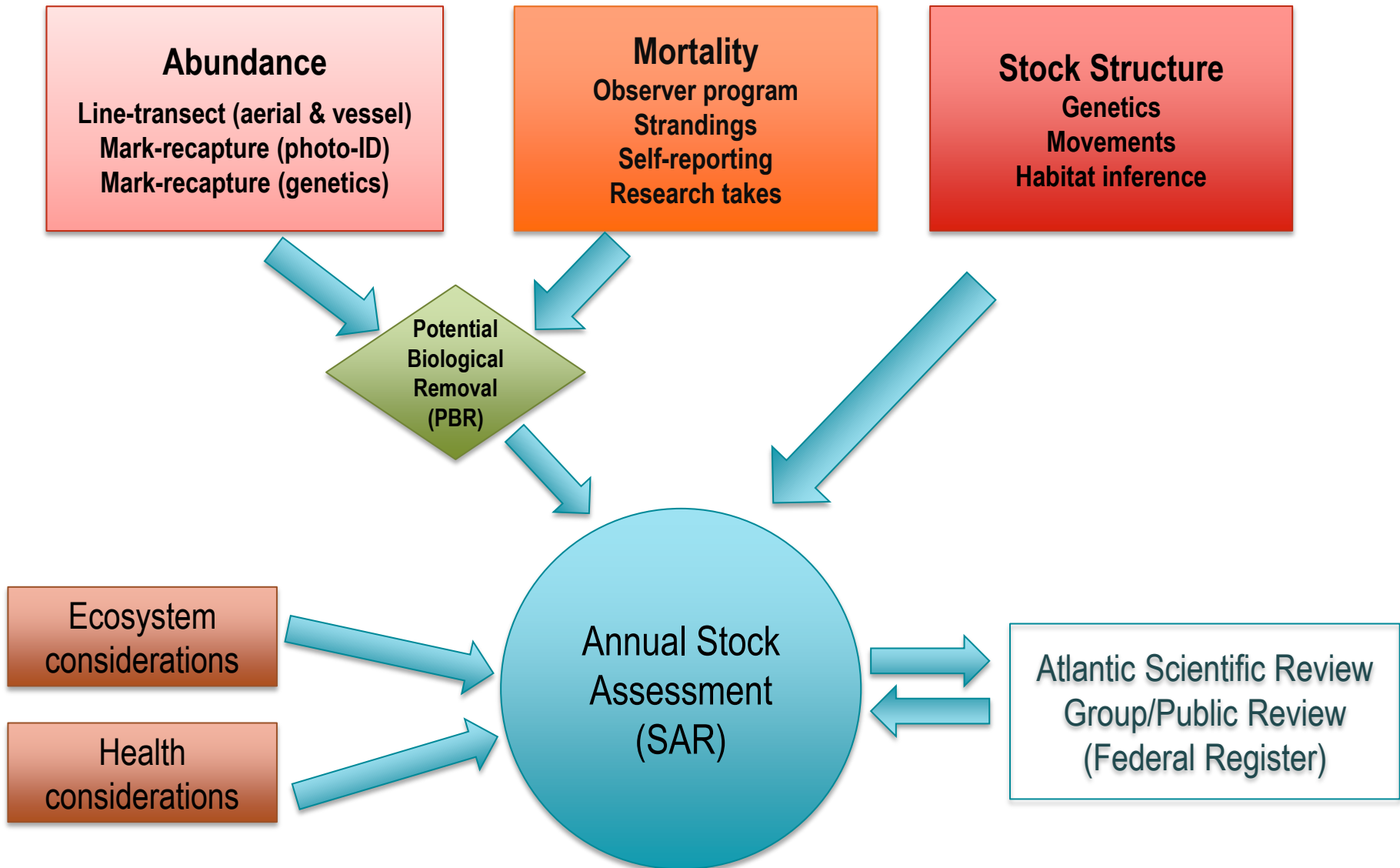
Bycatch is the unintentional catch of non-target species, including protected species, incidental to fishery operations

“Direct fisheries interactions pose a serious threat to many populations of marine mammals.” Read et al. 2008.

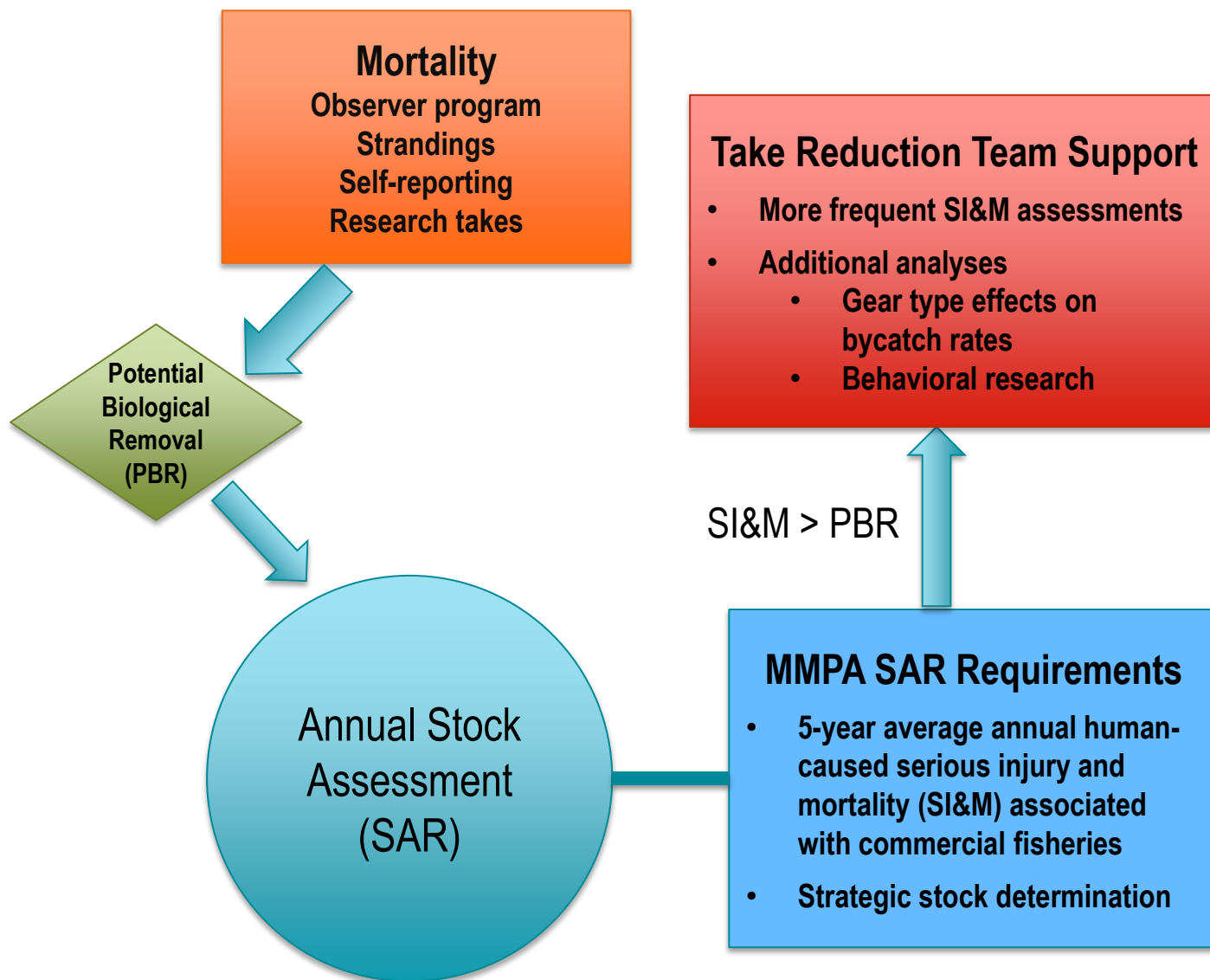
"Incidental take in fishing operations, or bycatch, is one of the most serious threats to the recovery and conservation of marine turtle populations." NOAA Office of Protected Resources.



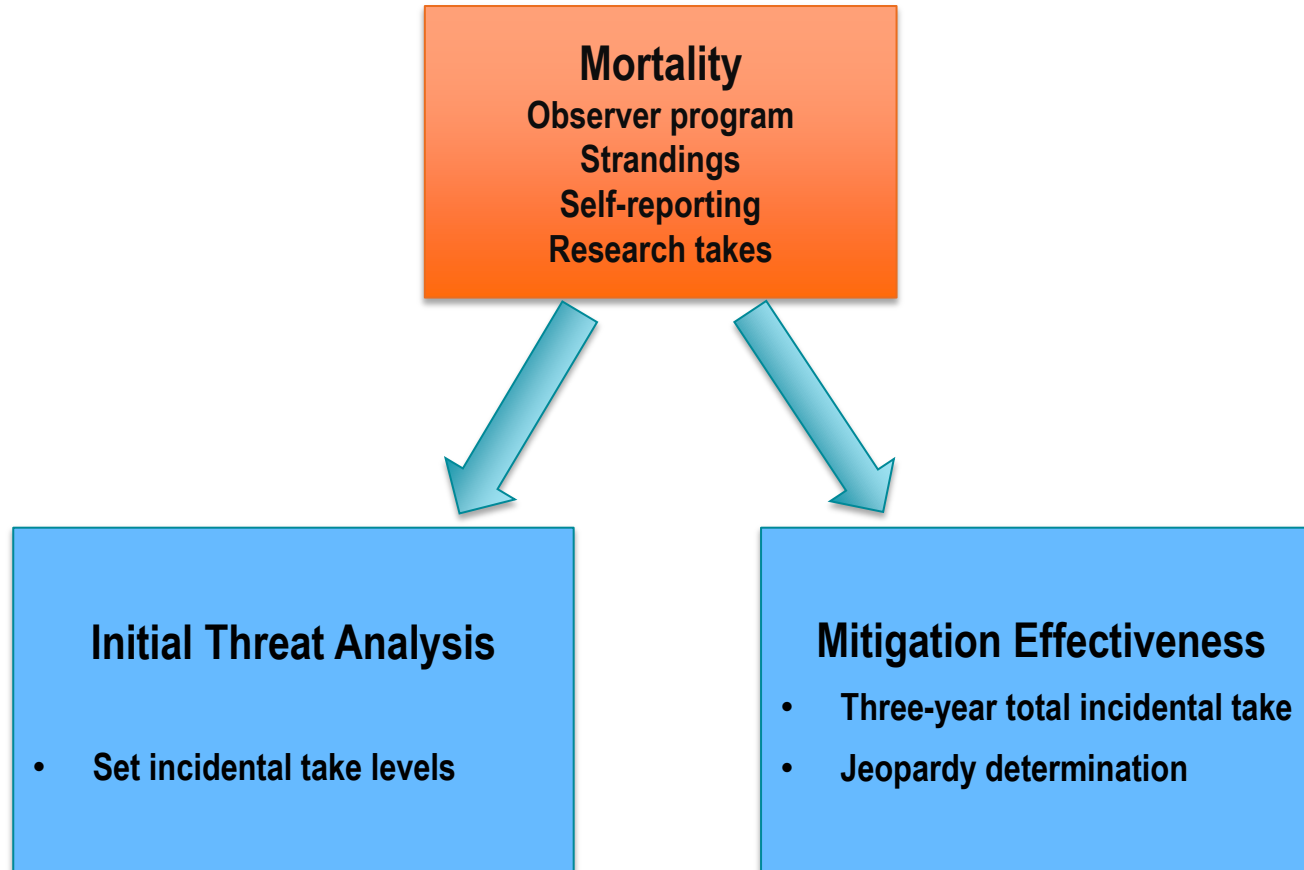
Marine Mammal Stock Assessments



Marine Mammal Stock Assessments



ESA Biological Opinion Incidental Take Statements



Marine Mammal Bycatch Estimation Standards

Standards focus on **precision** of estimates which is a function of sample size and is impacted by both **bycatch rate** and **observer program effort levels**

30% CV has been a benchmark for NOAA

Estimates for small populations can never reach that precision

Protected Species

Stock Assessment Improvement Plan and GPRA performance measures

Level 2: Minimum estimate

Level 3: Unbiased estimate with $CV \geq 30\%$

Level 4: Precise estimate with $CV < 30\%$

Guidelines for Assessing Marine Mammal Stocks

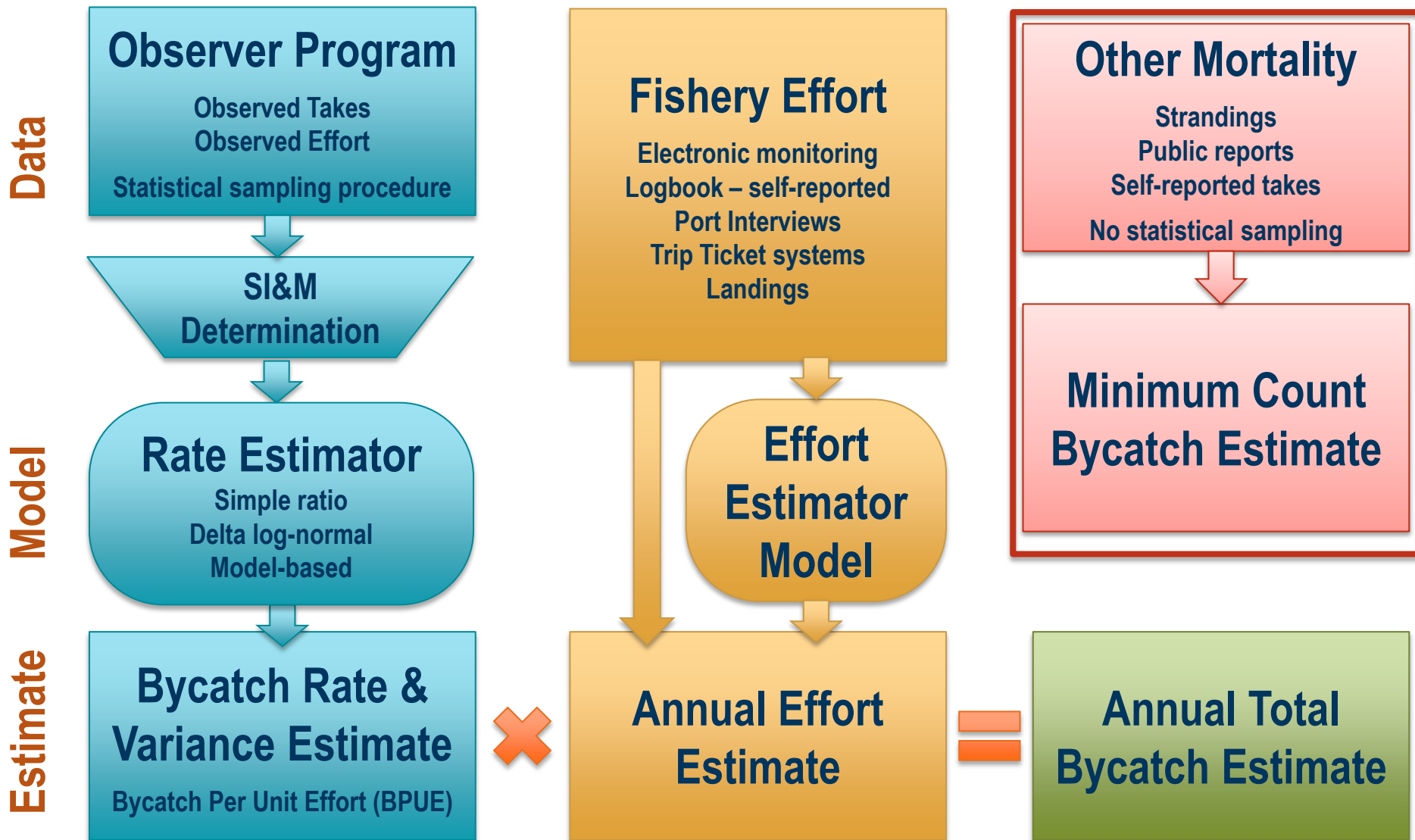
Decrease recovery factor (Fr) in PBR calculation
dependent upon CV of mortality estimate

Fr = 0.48 if CV is between 0.3-0.6

Fr = 0.45 if CV is between 0.6-0.8

Fr = 0.40 if CV is >0.8

Data Sources and Process for Estimation







Marine Mammal Serious Injury Determination

- “Serious Injury” (SI) is defined as an injury that will “more likely than not” result in the death of a marine mammal
- SI National Guidelines
 - Established in 1997 workshop - experts consulted on the probability of death for different injury types (e.g., hookings, entanglements, etc.)
 - Policy revision in 2012 - national guidelines for serious injury determinations for the science centers
- Individual cases are reviewed by center staff to determine whether or not the animal can be classified as “seriously injured” based on these guidelines. The classification is incorporated into the estimate of bycatch.

Southeast Fisheries With Known* Bycatch



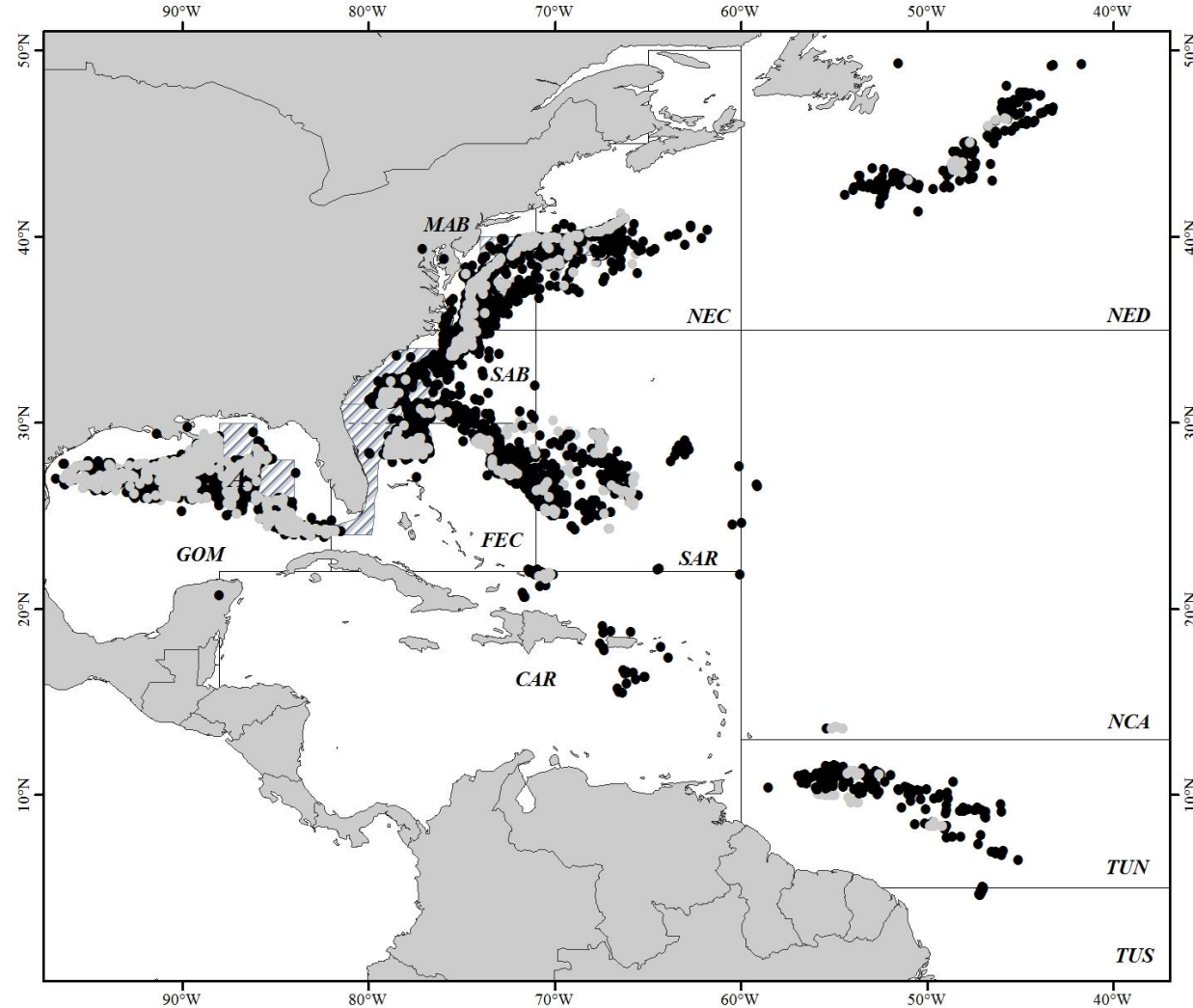
	Observer Program	Known bycatch		Annual total bycatch Estimate		Take Reduction Team	Sea Turtle BiOp
							
Atlantic Ocean, Caribbean, GOMx large pelagics longline	Y	Y	Y	Y	Y	Y	Y
SE US Atlantic, GOMx reef fish, snapper/grouper, shark, coastal migratory and dolphin/wahoo fisheries (Bottom longline, hook and line, harpoon)	Y	Y	Y	Y‡	Y	N	Y
SE US Atlantic shark gillnet	Y	Y	Y	Y	Y	Y	Y
Mid-Atlantic, SE Atlantic, and NC gillnet and other net fisheries (SE & NE)**	Y	Y	Y	Y‡	Y	Y	Y
SE US Atlantic, GOMx shrimp trawl	Fed	Y	Y	Y‡	Y	N	Y
GOMx menhaden purse seine	Pilot	Y	Y	N	N	N	N
SE US Atlantic, GOMx blue crab, stone crab, & spiny lobster trap / pots	N	Y	Y	N	N	Y	Y
SE US Atlantic, GOMx recreational fisheries (hook&line, trap/pots, gillnets)	N	Y	Y	N	N	N	N

* Additional SE fisheries may have bycatch, by analogy of gear type

‡ Annual bycatch estimate only available for some of these fisheries

** Bottlenose dolphin stocks are managed by SE; Observer programs are run through NE, SE, and NC; Additional NE fisheries also affect these stocks.

Pelagic Longline Fishery



Observed (grey) and Reported (black) PLL Fishery Effort during 2013

Observed since 1992 with a target annual coverage rate of 8%

Fishery targets tunas and swordfish with pelagic longlines typically 10-40 miles in length

2004 biological opinion on sea turtles require use of circle hooks throughout the fishery

Subject of pelagic longline take reduction plan to reduce bycatch of pilot whales in the Mid-Atlantic Bight fishing area

Pelagic Longline Fishery – Bycatch Estimation

Delta-Lognormal estimator - large number of “zeros”

Level of observation - individual set

Unit of effort – number of hooks

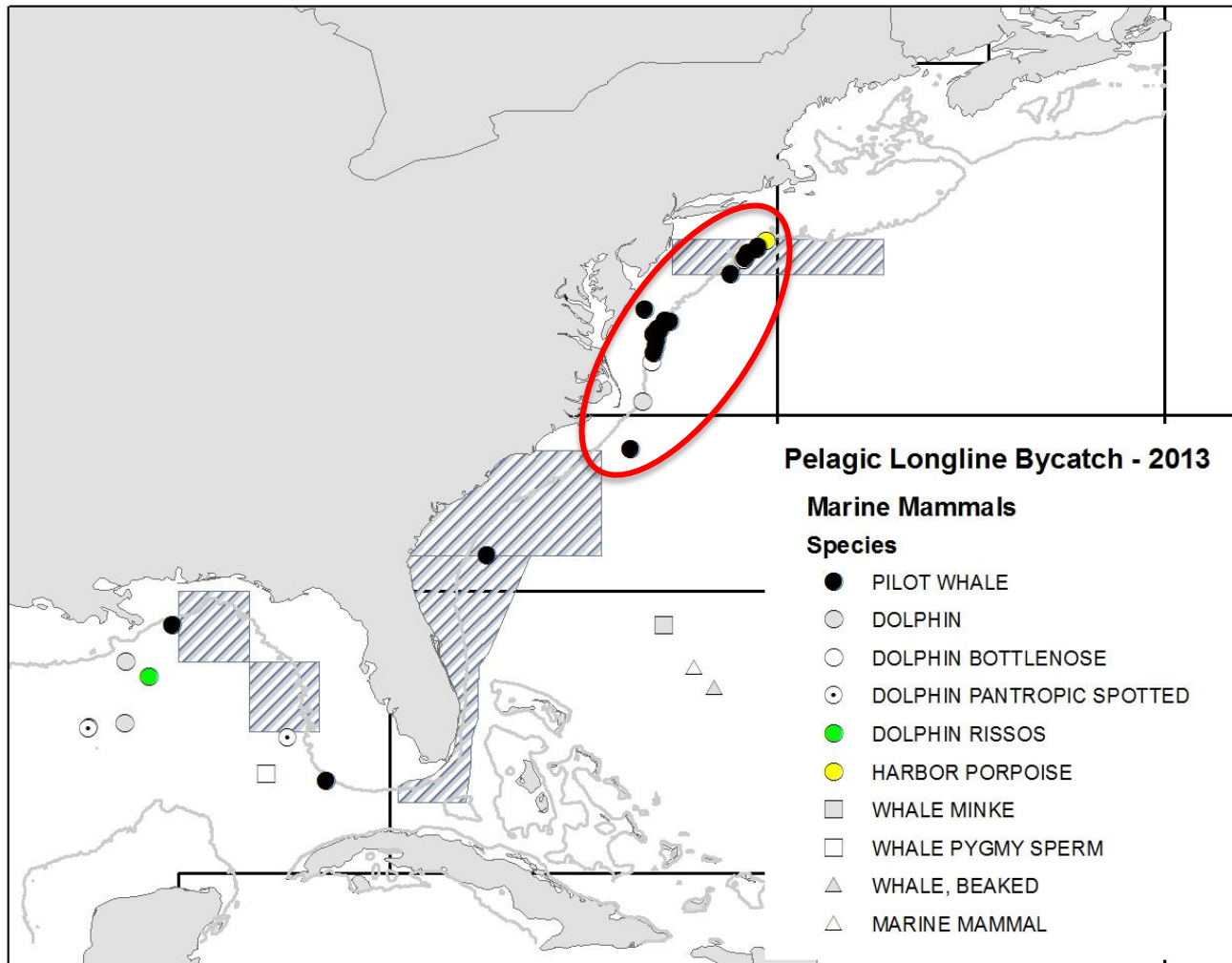
Bycatch rate and effort stratified by AREA and QUARTER, summed to estimate total bycatch

Prior years are used to impute values for missing Area/Quarter cells in any given year

Key Delta-Lognormal assumptions have not been critically evaluated
(see recent review: Christman 2014)

- 1) random sampling of fleet
- 2) accurate reporting of total effort
- 3) lognormal distribution of catch in positive sets
- 4) linear relationship between number of hooks and bycatch

Marine Mammal Serious Injury and Mortality - 2013



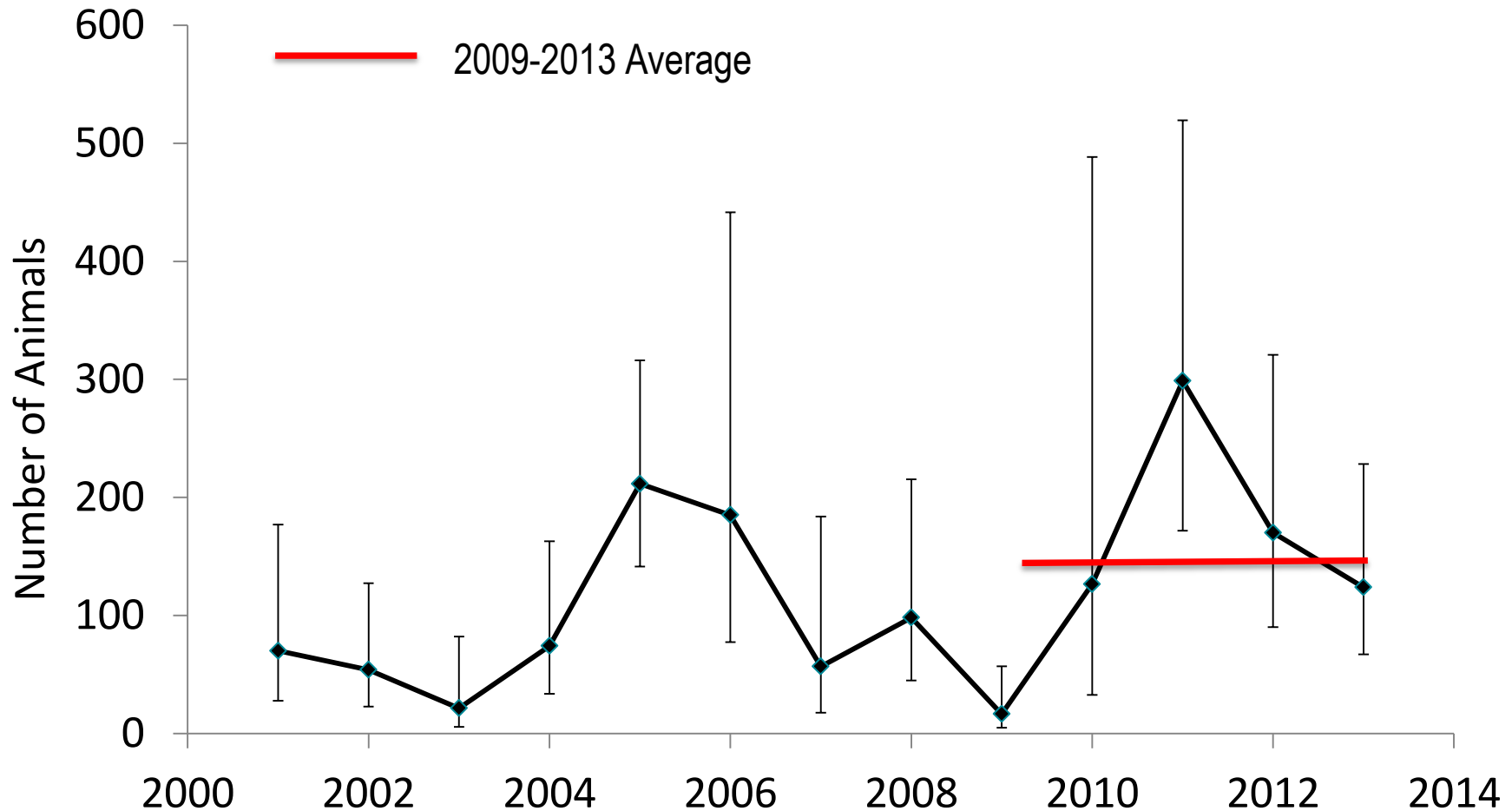
Marine mammal interaction typically highest along shelf-break in Mid-Atlantic Bight with pilot whales

Low rate, but more diverse species in the Gulf of Mexico associated with elevated observer coverage in 2nd quarter

Interactions are typically entanglements in mainline or mouth hookings

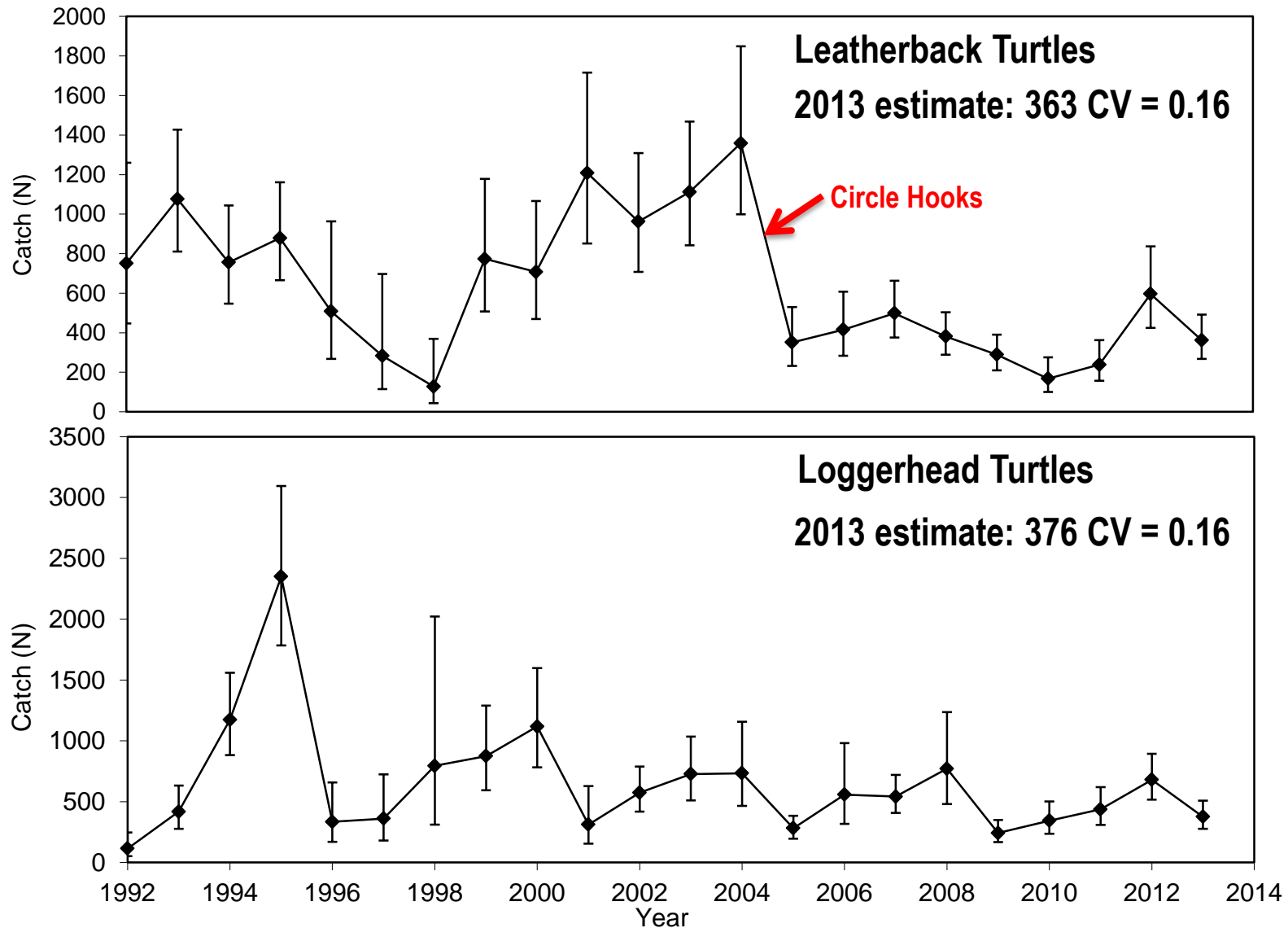
Roughly 50% of interactions are serious injuries with most of those being hooks in the mouth

Annual Pilot Whale SI and Mortality: 2001-2013

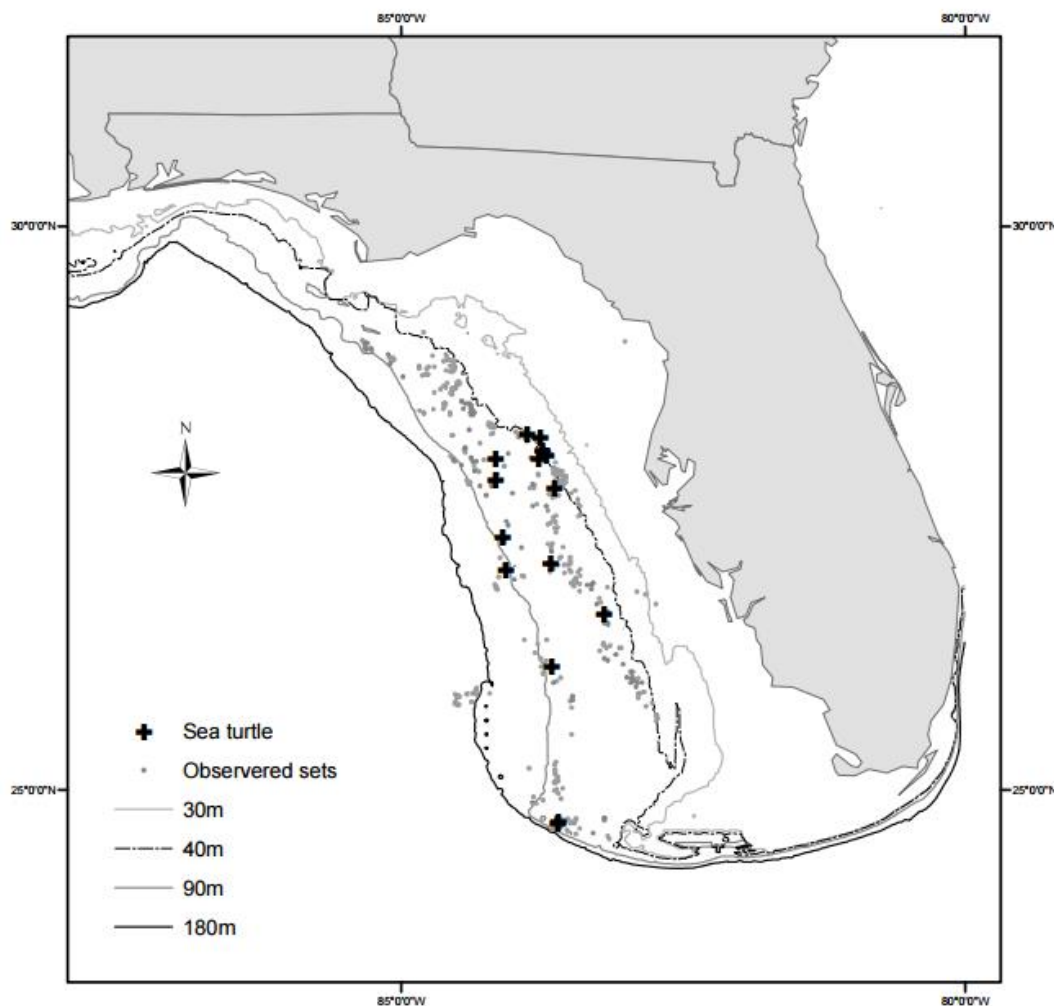


Annual Average SI&M of Short-finned pilot whales: 148 (CV = 0.201)

PLL Fishery – Sea Turtle Interactions



Bottom Longline Fisheries



Total effort

Coastal logbook data

all bottom long-line gear

- self-reported
- trip-based

Catch rates

Observer data – set-based, stratified

Two observer programs

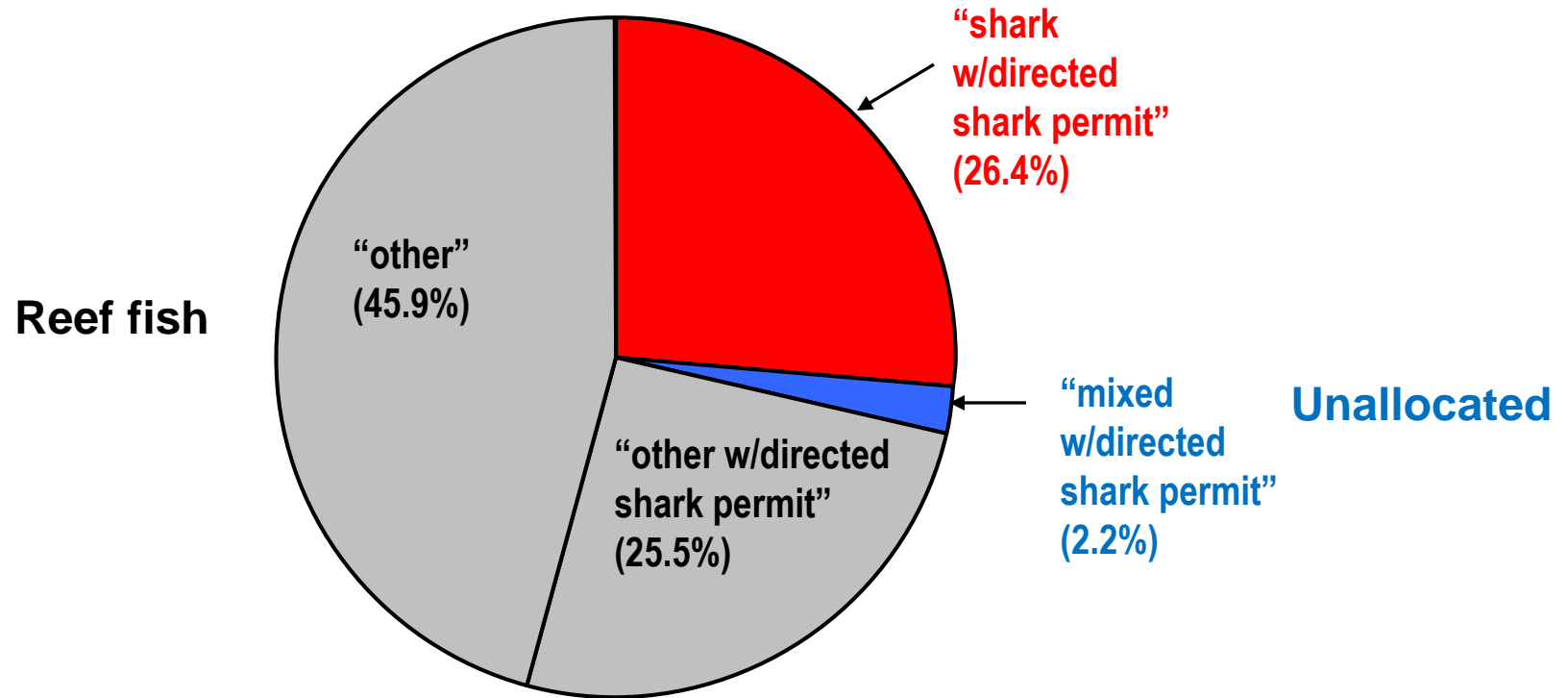
- Shark bottom longline observer program (SBLOP)
- Reef fish observer program (RFOP)

SEFSC 2008 PRD 07/08-15: 2006-2007 fishery effort and sea turtle takes

Bottom Longline Trip Classification

Effort allocation to fisheries based on landings

(2/3 shark by weight = Shark Directed)



Shark directed = "shark w/directed shark permit"

Reef fish = "other" – no directed shark permit
+ "other w/directed shark permit"

Unallocated = "mixed" – neither shark directed nor reef fish

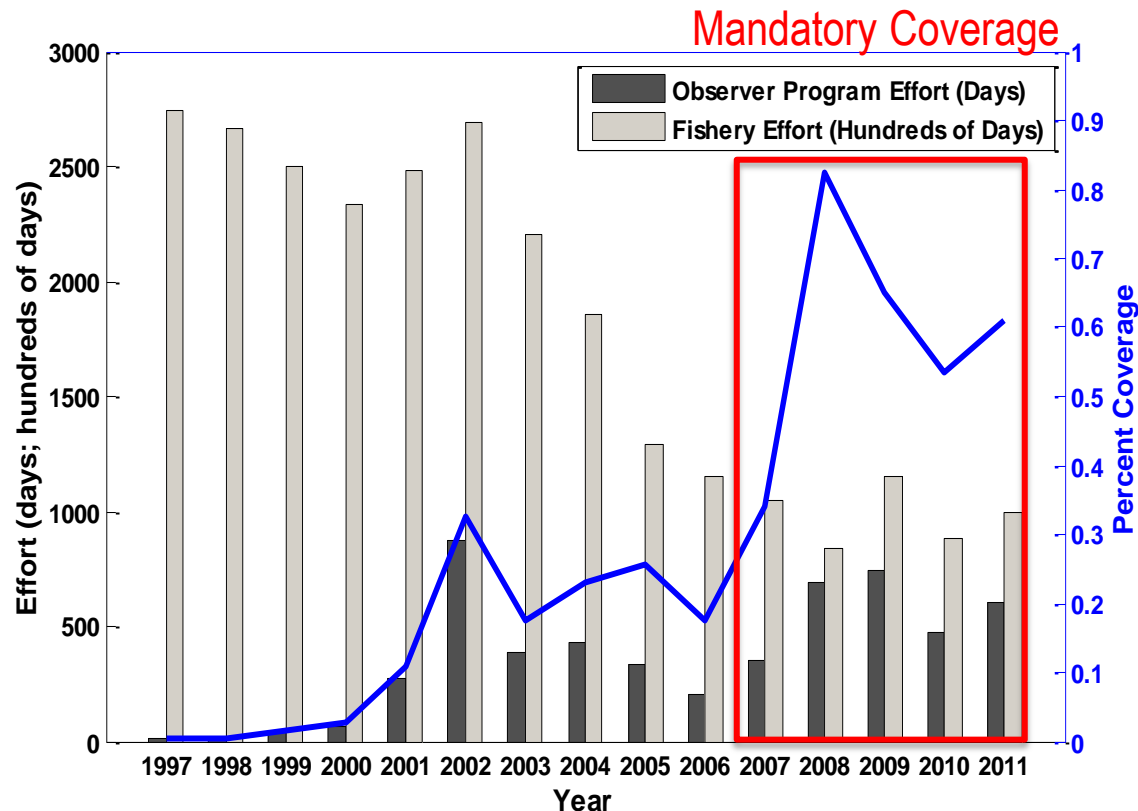
Bottom Longline – Rarity Problem

Management approach to dealing with low bycatch rates

- “NMFS will observe a minimum of 100,000 bottom longline hooks per year...”
- “If one or fewer loggerhead takes are observed per 100,000 bottom longline hooks it will confirm that the take rate is so rare as to allow us to confidently conclude that the annual take is below that analyzed in this opinion.”

2011 Biological Opinion on the Gulf of Mexico Reef Fish Fishery.

GOMx Shrimp Trawl Fishery



Fishery Data

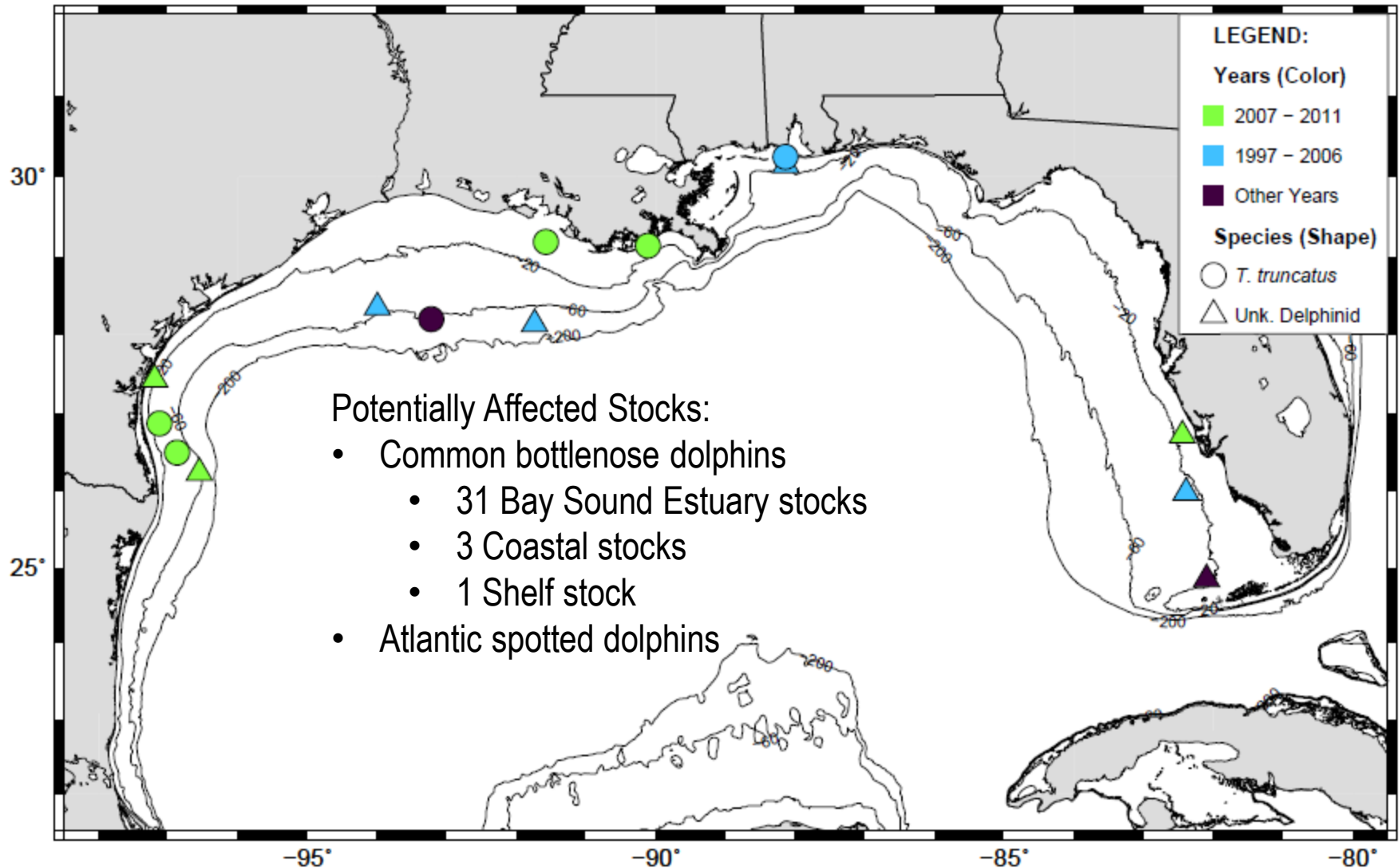
- Total Effort - Nominal Days Fished
- Stratified
 - State Area
 - Season
 - Depth
- Inshore skimmer effort removed (50% of effort LA, AL/MS only)

Observer Program Data

- CPUE – Observed Takes per Day Fished
- Averages 0.5% coverage of fishery
- No inshore coverage

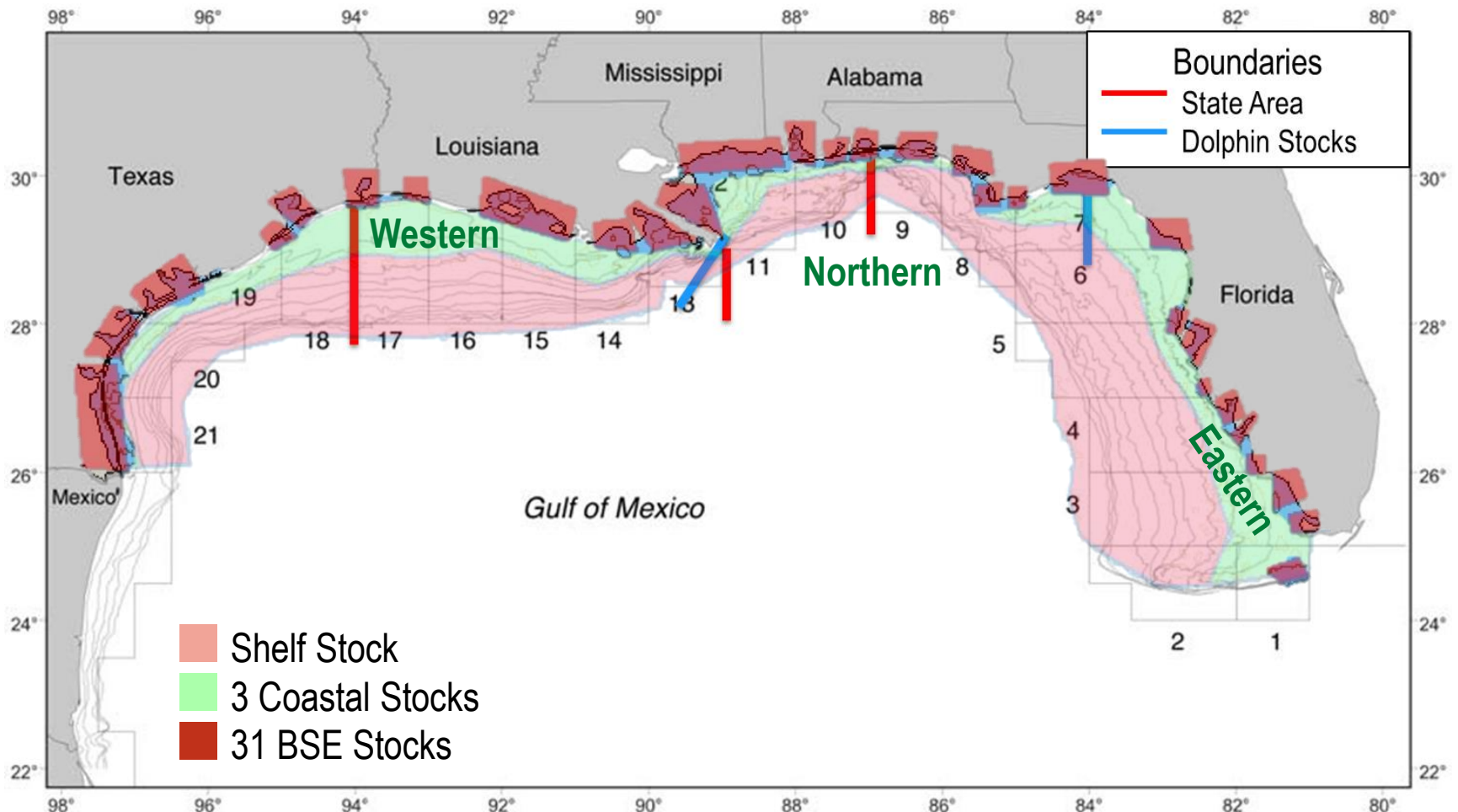
Soldevilla et al 2015 NOAA TM NMFS-SEFSC-672

Shrimp Trawl Fishery – Marine Mammal Bycatch



Shrimp Trawl Fishery – State Areas and Stock Boundaries

Fishery Effort is calculated based upon state area boundaries that do not correlate exactly to stock boundaries.



Shrimp Trawl Fishery – MM Bycatch Estimator

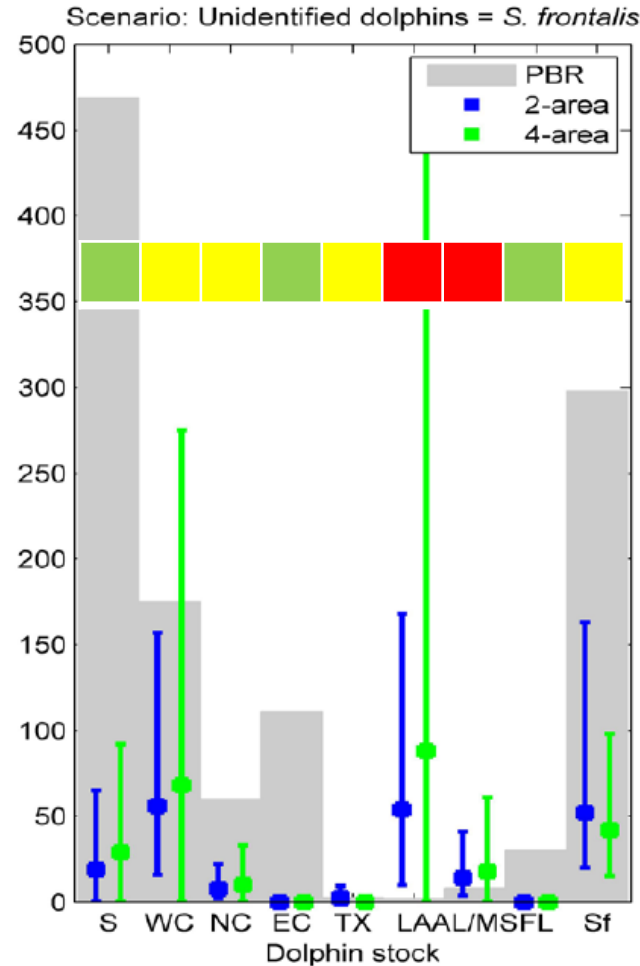
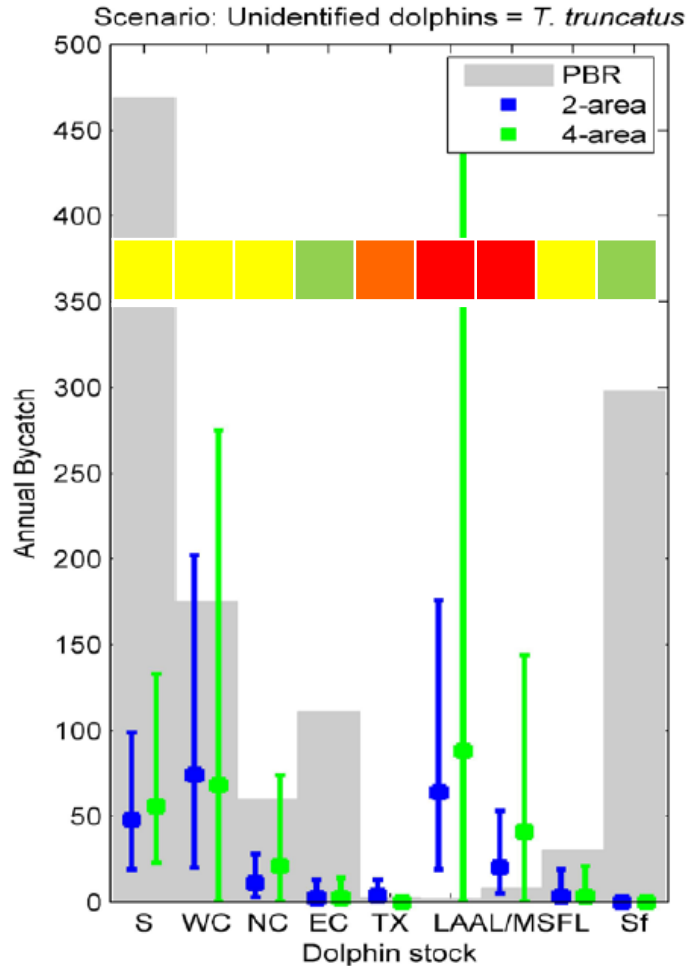
- Two Stratification Methods
- Stratified Bycatch Rate
- Stratified bycatch rates pooled over 15 years of data
- Nearshore bycatch rates assigned to Inshore strata
- Consider best and worst case scenarios for each species:
 1. All unidentified dolphins = Bottlenose (Worst Tt, Best Sf)
 2. All unidentified dolphins = Spotted (Best Tt, Worst Sf)
- Ratio of means estimator: $\text{Annual bycatch} = \text{Effort} * \text{CPUE}$

Tt: *Tursiops truncatus*, Bottlenose dolphin;

Sf: *Stenella frontalis*, Atlantic spotted dolphin

Shrimp Trawl Fishery – MM Bycatch Estimates

2007-2011 Mean Annual Bycatch Mortalities



Multiple models

PBR values from 2014 SARs

Outdated for most BSE stocks

Least Concern	<10%
Moderate Concern	10 – 49%
High Concern	50 – 99%
Highest Concern	>100%

Shrimp Trawl Fishery – Data Limitations and Assumptions

Dolphin Biology

- Outdated BSE stocks abundance estimates
- Stock delineations vs. Fishery strata
- Species identifications
- Animal disposition (alive, “decomposed”)

Observer Coverage

- Low observer coverage
- Voluntary coverage 1997-2006
- No inshore coverage
- No skimmers coverage

Fishery Effort

- Low resolution in inshore waters compared to stock boundaries
- Inshore effort combines skimmers and otter trawls

Trawl Entanglement – Data Challenges



Photo from Shrimp Observer Program

Skimmer Vessel



Photo from Scott-Denton et al 2006

Protected Species and Unobserved Fisheries

- Crab pots, commercial and recreational hook and line fisheries, and menhaden fishery have documented interactions and no observer programs
- Document interactions and serious injuries through stranding network and public reports
- Minimum counts of interactions are included in stock assessment reports
- Pilot observer program in 2010-2011 for menhaden fishery
- Challenge to observe and quantify effort in small-vessel fisheries

Strengths

- Longline observer coverage very high, well-trained observers, dedicated data collection for protected species
- Precise estimates for focal species (turtles, pilot whales) in pelagic longline
- Developed first estimates of mammal bycatch in shrimp fishery for federal waters
- Increasing number of fisheries have observer programs yielding new bycatch estimates

Challenges

- Observer coverage spatial gaps (e.g., inshore waters for shrimp fishery) and allocation
- Observing protected species interactions in shrimp and menhaden fisheries
- Need alternative platforms to observe small vessel and land/pier based fisheries
- More requirements than we are capable of fulfilling, and loads are increasing
- Management baselines based on means without variance
- Increasing use of electronic monitoring limits biological sampling

Future Directions

- In Progress:
 - Seeking funding for inshore coverage of shrimp fishery
 - Behavioral interaction and gear modification studies
- Explore alternative platforms for observing small vessel and land based fisheries
- Improve protected species data collection
- Further develop analytical tools

Discussion Questions

- Is the work we are doing reflective of scientific best practices?
- Do you see an opportunity for SEFSC to shift resources from an existing activity to deal with an unmet need?
- Are research studies on bycatch reduction and gear development being conducted properly (design, statistical rigor, standardization)? What are the strengths and weaknesses of fishery dependent vs. fishery independent studies? Are there alternatives to captive rearing for conducting gear testing/evaluations?
- Discuss the major limitations/weaknesses of the bycatch estimation and reduction studies and how could they be resolved?